

New record of a parasitising species of *Hydrachna* (Acari, Hydrachnidia) on water beetles *Eretes griseus* (Fabricius, 1781) (Coleoptera, Dytiscidae, Dytiscinae, Eretini)

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Abstract

The larvae of water mites of the genus *Hydrachna* parasitise water bugs and water beetles. Larvae of the genus *Hydrachna* attach to the thorax and abdomen sternites and tergites under the elytra. Up to now six species of *Hydrachna* were recorded from Iran, but there are no records on larvae parasitising on water beetles. There is some information about parasitising of *Hydrachna* on water beetles from the genus *Eretes*, which is very well adapted to dry climate. The aim of this paper is to describe the morphology of an unknown larva of the genus *Hydrachna*, found on *Eretes griseus*.

Keywords

Iran, larva, morphological features, taxonomic status, water beetles, water mites

Introduction

Many organisms are dependent on a living host for some part of their life cycle or even the whole life. These symbiotic relationships categorised as mutualistic, commensal or parasitic, while specific specialisation occurs in commensalism and mutualistic symbionts, higher levels of co-evolution can be found in parasitic relationships. Among different groups of mites, larval stages of the cohort Parasitengonina parasitise a wide range of arthropods including terrestrial, freshwater or marine insects (Zawal 2003a; Baker et al. 2008; Normant et al. 2013; Mortazavi et al. 2018).

Beetles of the genus *Eretes* are specifically adapted to desert environments and a dry climate, where they can find small and isolated, warm, standing, water sources such as pools with clayey or sandy bottom and little vegetation (Hájek et al. 2014; Miller 2002). The water mites of subcohort Hydrachnidae are well known as parasites of water beetles. Larval instars of the genus *Acherontacarus* Angellier attach to the mesosternal region of their host beetles (Aykut et al. 2018), larvae of the genus *Hydrachna* Muller attach to thorax and abdomen sternites and tergites under the elytra (Zawal 2002), while larvae of genus *Eylais* Latreille mostly hide under the beetle's elytra (Zawal 2003b). In this study, we found three larvae of *Hydrachna* sp. attaching to the mesosternal area of the dytiscid host beetle *Eretes griseus* (Fabricius, 1781) (Fig. 2).

Material examined

The larvae were collected as parasites on *Eretes griseus* from a volcanic area on a mountainside, nearly 1,840 meters above the sea level, Badab-e Soort) 36.3549N, 53.8565E (in Mazandarn province, northern Iran (Fig. 1). This natural site comprises two mineral hot springs, one with sour and the other with salty water. Over thousands of years, flowing water from these springs has formed numbers of red, orange, and yellow staircase pools each filled with some amount of mineral water. We collected the host beetle with a net from one of the lower pools as it was swimming.

All small larvae (0.15–0.40 mm) were detached from surfaces of the mesosternum of the beetle body (Fig. 2). They were cleared with lactic acid and mounted in Hoyer's medium. Morphological observations, measurements, and illustrations were made using compound microscopes (Zeiss Axio Scope.A1) equipped with phase contrast optical systems and a camera lucida (Olympus BX51).

Idiosomal setae are named according to Prasad and Cook (1972):

Cx-1-3	coxal plates,
Hu	humeral seta,
L	length,
Lp1, Lp2	lateropropodosomal setae,
Lh3	laterohysterosomal seta,
Mh1, Mh2, Mh3, Mh4	mediohysterosomal setae,



Figure 1. Photographs of sampling site.

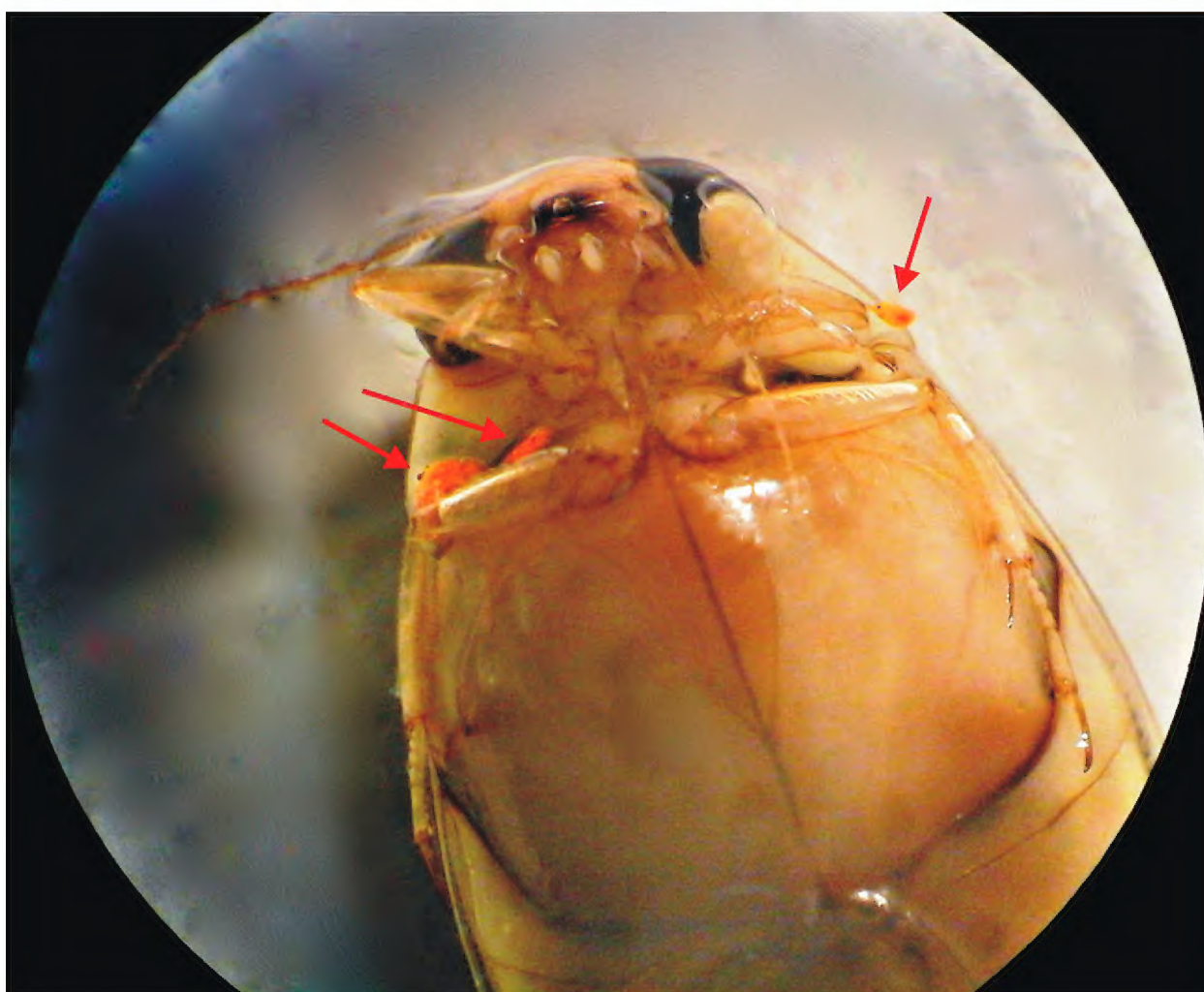


Figure 2. Larvae of *Hydrachna* sp. attached to *Eretes griseus*.

Mp1, Mp2	mediopropodosomal setae,
n	number of specimens measured,
P-1-5	pedipalp segments (trochanter, femur, genu, tibia and tarsus),
I-Leg-1-5	first leg, segments 1-5 (trochanter, femur, genu, tibia and tarsus) i.e.,
III-Leg-3	genu of third leg,
W	width.

All measurements are given in micrometres (μm).

Taxonomic account

Superfamily HYDRACHNOIDEA

Family Hydrachnidae Leach, 1815

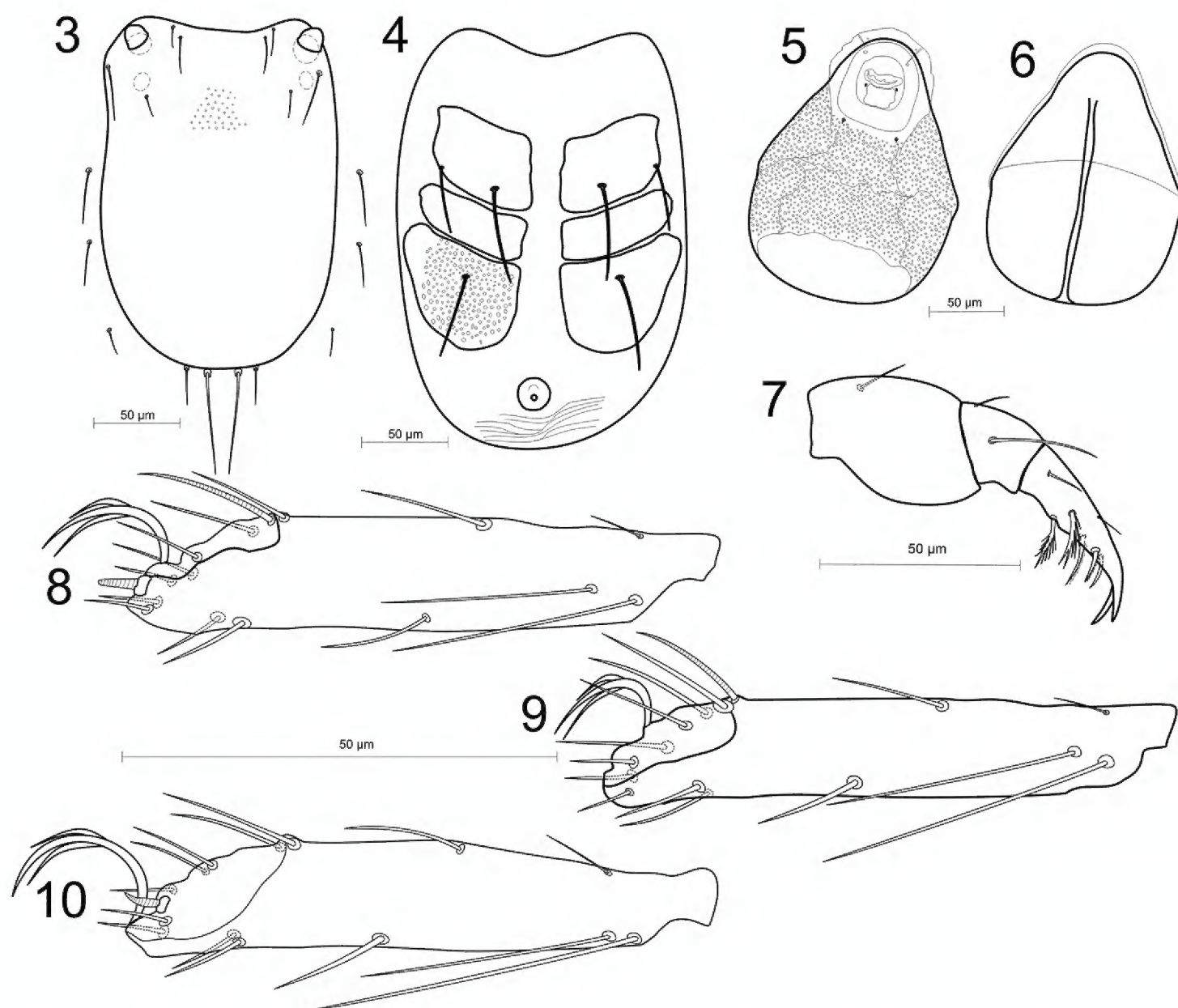
Genus *Hydrachna* Müller, 1776

***Hydrachna* sp.**

Figs 3–11

Description. The idiosoma are oval, with the integument striated, and the dorsal plate is very large, covering the whole idiosoma of unengorged larva, the integument pointed and with a concave anterior edge (Figs 3, 11). There are four pairs of setae on the dorsal plate (Mp1, Lp1, Lp2, Hu). The basal bodies of Mp2 on dorsal plate invisible; setae Mh1, Mh2, Mh3 located on soft integument (Fig. 4). There are three pairs of coxal plates located on the proximal half of the idiosoma, and all are wider than long. Median edges of coxa I and III almost the same length and two time longer then coxa II. The anterior coxa bears two setae, the medial coxa is without seta, and the posterior coxa has one seta. The excretory pore plate is very large and is located behind of coxal plates (Figs 5, 11). Gnathosoma short, strongly tapering forward; gnathosomal sucker large, discoid with corrugated borders (Figs 5, 6). Pedipalps relatively short and thin: femur stocky with strongly convex ventral margin and one seta; genu with two setae and concave ventral margin; tibiotarsus relatively long with two claws the same size, weakly bent, five tibiotarsal spines, four of them pinnate (Fig. 7). Trochanters of all legs with one seta, all femora with four setae and with one swimming seta on I and II and two swimming setae on III femora. Genu I with five setae including two swimming setae, genu II and III with four setae including one swimming seta. All tibiae with five setae including one swimming seta, and with one solenidium. Tarsi each have 14 setae including two swimming setae, tarsi I and II have one solenidium, and tarsi I and III have one eupathidium (Figs 8–10).

Measurements. In μm , $n = 3$. Dorsal plate: L/W 250–254/162–157; coxal plates: Cx-1 L 40–45, Cx-2 L 20–22, Cx-3 42–44; excretory pore plate L/W 17–18/16–17; gnathosoma; L/W 173–176/138–140; diameter of sucker ring 71–73; pedipalpal



Figures 3–10. *Hydrachna* sp. **3** dorsal plate **4** ventral side **5** gnathosoma ventral side **6** gnathosoma dorsal side **7** pedipalp **8** I-leg-5 **9** II-leg-5 **10** III-leg-5.

segments (P-1–3) L: 8–9, 36–38, 39–42; leg segments L: I-leg 1–5: 18–19, 37–39, 32–34, 38–40, 67–69; II-leg 1–5: 20–21, 32–34, 29–30, 37–39, 68–70; III-leg 1–5: 28–29, 29–30, 27–28, 38–40, 61–64.

Remarks. The larva of *Hydrachna* sp. is most similar to larvae of *H. processifera* described by Wainstein (1980) as a *H. inermis* (Aykut et al. 2018). It is similar in the shape of coxal plates, the discoidal hypostomal sucker, the tibiotarsus relatively long with two claws the same size, weakly bent; five tibiotarsal spines the same size. It is different by the presence of a eupathidium on tarsus leg-2; localisation the Mh1, Mh2, and Mh3 setae outside of the dorsal plate on soft integument, and the presence of a very large excretory pore plate. The last two features are very strange and different from all other species of *Hydrachna*. These differences indicate the probability of a separate subgenus to which the described larva would belong.

Thor (1916) split the genus *Hydrachna* into five subgenera: *Hydrachna* s. str., *Anahydrachna*, *Diplohydrachna*, *Schizohydrachna*, and *Monochydrachna*; subsequently he synonymised *Monochydrachna* with *Hydrachna* s. str., and *Schizohydrachna* with *Diplo-*

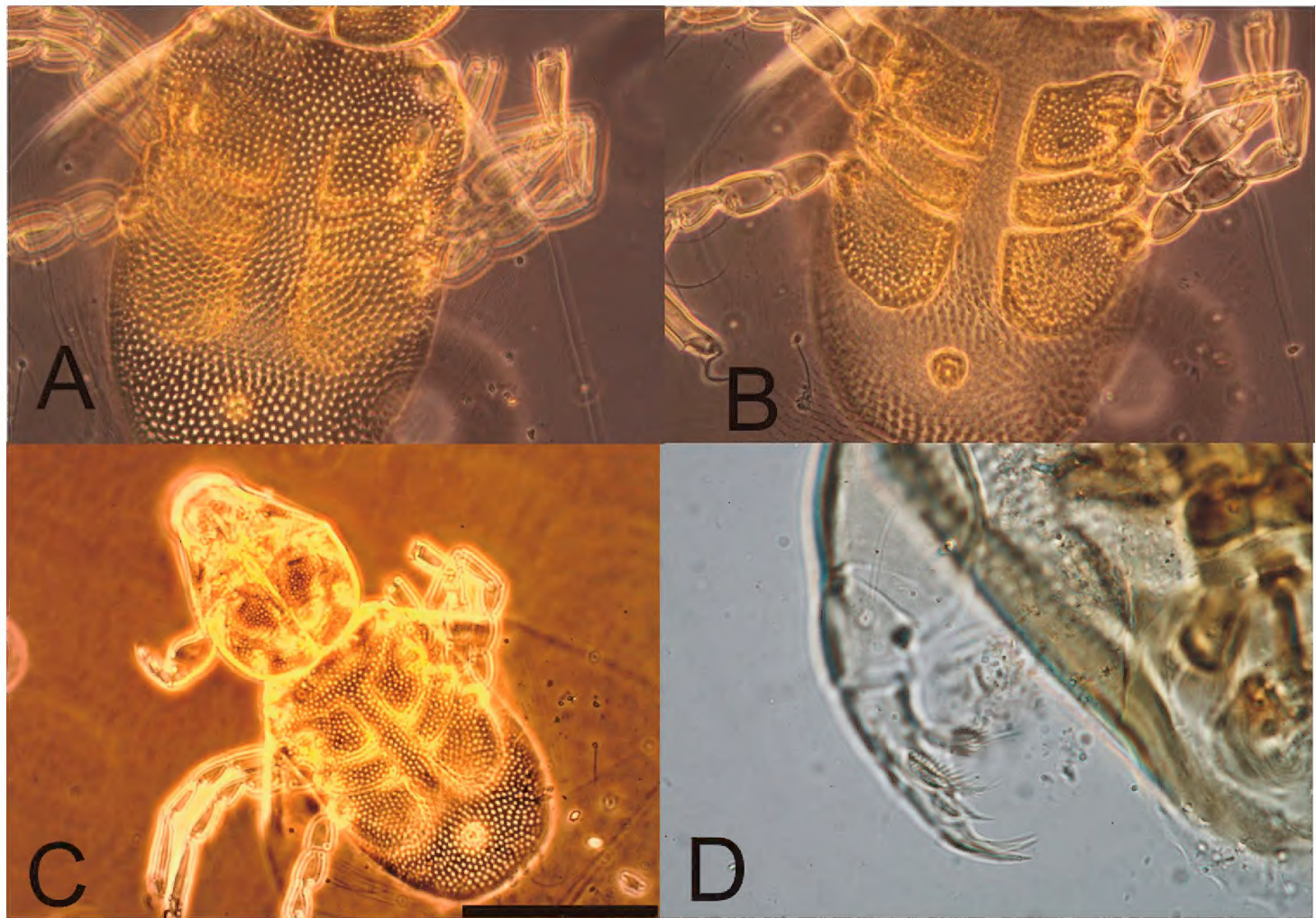


Figure 11. Photographs of *Hydrachna* sp. from *Eretes griseus* **A** dorsal plate **B** ventral side **C** dorsal view **D** pedipalp.

hydrachna, and established two more subgenera: *Rhabdohydrachna* and *Scutochydrachna* (Thor 1925). Davids et al. (2007) stated the differences between these subgenera were not clear and he abolished the division into subgenera.

At the current level of research, we propose to leave the taxonomy of the genus *Hydrachna* without sub-division, indicating the existence of greater morphological differentiation. Relationships within the genus of *Hydrachna* should be recognised on the basis of molecular studies and a decision on the possible splitting the genus into subgenera should be made. Up to now six species of *Hydrachna* were recorded from Iran (*H. cruenta*, *H. skorikowi*, *H. sepasgozariani*, *H. cf. vaillanti*, *H. sistanica*, *H. globosa lacerata*), and two of them (*H. sepasgozariani*, *H. cf. vaillanti*) belong to the *Hydrachna processifera* group of species (Pešić and Saboori 2007; Pešić et al. 2012, 2014). Larvae were described only for *H. cruenta*, *H. skorikowi*, and *H. globosa* (Wainstein 1980). The morphology of this larva and its parasitism on Dytiscidae show plausible grounds for it belonging to the *H. processifera* group of species and possibly to one of the two species from Iran (*H. sepasgozariani* or *H. cf. vaillanti*) for which the larvae are still not described. On the other hand, the differences in morphology (localisation the Mh1, Mh2, Mh3 setae outside of dorsal plate, on soft integument and very large excretory pore plate) indicate that it could belong to another species.

References

- Aykut M, Zawal A, Esen Y, Erman O (2018) First record of larvae of the water mite *Hydrachna processifera* Piersig, 1895 from Turkey (Acari, Hydrachnidia, Hydrachnidae). *ZooKeys* 738: 89–96. <https://doi.org/10.3897/zookeys.738.21021>
- Baker RA, Mill PJ, Zawal A (2008) Ectoparasitic water mite larvae of the genus *Arrenurus* on the damselfly *Coenagrion puella* (Linnaeus) (Zygoptera: Coenagrionidae). *Odonatologica* 31(3): 193–202.
- Biesiadka E, Cichocka M (1994) Water mites (Hydracarina) – parasites of water bugs of the group Nepomorpha. *Polskie Pismo Entomologiczne* 63: 357–368. [in Polish]
- Cichocka M (1995) Parasitism by Hydracarina upon aquatic Heteroptera from the group Nepomorpha in the lakes of Szczytno. *Acta Parasitologica* 40: 94–99.
- Davids C (1973) The water mite *Hydrachna conjecta* Koenike, 1895 (Acari, Hydrachnellae), bionomics and relation to species of Corixidae (Hemiptera). – *Netherlands Journal of Zoology* 23: 363–429. <https://doi.org/10.1163/002829673X00012>
- Davids C, Di Sabatino A, Gerecke R, Gledhill T, Smit H, Van der Hammen H (2007) Acari: Hydrachnidia. In: Gerecke R (Ed.) *Chelicerata: Araneae, Acari I' Süßwasserfauna von Mitteleuropa* 7/2–1: 241–388.
- Hájek J, Hendrich L, Vyhnálek V, Csabai Z (2014) *Eretes* diving beetles (Coleoptera: Dytiscidae) in Central Europe – witnesses of climate change? *Aquatic Insects* 36: 267–271. <https://doi.org/10.1080/01650424.2015.1079639>
- Miller KB (2002) Revision of the Genus *Eretes* Laporte, 1833 (Coleoptera: Dytiscidae). *Aquatic Insects* 24: 247–272. <https://doi.org/10.1076/aqin.24.4.247.8238>
- Mortazavi A, Hajiqaanbar H, Linquist EE (2018) A new family of mites (Acari: Prostigmata: Raphignathina), highly specialized subelytral parasites of dytiscid water beetles (Coleoptera: Dytiscidae: Dytiscinae). *Zoological Journal of the Linnean Society* 184: 695–749. <https://doi.org/10.1093/zoolinlean/zlx113>
- Normant M, Zawal A, Chatterjee T, Wójcik D (2013) Epibiotic mites associated with the invasive Chinese mitten crab *Eriocheir sinensis* – new records of Halacaridae from Poland. *Oceanologia* 55(4): 901–915. <https://doi.org/10.5697/oc.55-4.901>
- Pešić V, Saboori A (2007) A checklist of the water mites (Acari: Hydrachnidia) of Iran. *Zootaxa* 1473: 45–68. <https://doi.org/10.11646/zootaxa.1473.1.3>
- Pešić V, Smit H, Saboori A (2012) Water mites delineating the Oriental and Palaearctic regions – the unique fauna of southern Iran, with description of one new genus, one new subgenus and 14 new species (Acari: Hydrachnidia). *Zootaxa* 3330: 1–67. <https://doi.org/10.11646/zootaxa.3330.1.1>
- Pešić V, Smit H, Saboori A (2014) Checklist of the water mites (Acari, Hydrachnidia) of Iran: Second supplement and description of one new species. *Ecologica Montenegrina* 1(1): 30–48. <http://zoobank.org/0598457D-2B06-4F92-BD16-BD5A98E6092E>
- Prasad V, Cook DR (1972) The taxonomy of water mite larvae. *Memoirs of the American Entomological Institute* 18: 1–326.

- Smith IM, Oliver DR (1986) Review of parasitic associations of larval water mites (Acari: Parasitengona: Hydrachnida) with insect hosts. *The Canadian Entomologist* 118: 407–472. <https://doi.org/10.4039/Ent118407-5>
- Taşar GE, Erman O, Polat A, İncekara Ü (2012) Phoresy on the aquatic Coleoptera: Helophoridae and Hydrophilidae species in Lake Van Basin, Turkey. *Munis Entomology and Zoology* 7: 867–886.
- Thor S (1916) Sur le genre *Hydrachna* Müll. et sur des nouvelles espèces provenant principalement de la Russie (Acarina, Hydrachnidae). *Russkaja Entomological Observation* 16(1–2): 46–63.
- Thor S (1925) Phylogeny and systematics of the Acarina, with contribution to the early phylogeny of various groups. IV. Contribution to the ontogeny of the Acarina. *Nyt Magazin for Naturvidenskaberne* 62: 123–167.
- Wainstein BA (1980) *Opredelitel' lichinok vodyanykh kleshchey* [Key to water mite larvae]. Nauka, Leningrad, 238 pp. [In Russian]
- Zawal A (2002) Parasitism of water mite larvae (Hydrachnellae) of the genus *Hydrachna* on water beetles in Poland. *Acarologia* 42: 361–370.
- Zawal A (2003a) The role of insects in the dispersion of water mites. *Acta Biologica Universitatis Daugavpiliensis* 3: 9–14.
- Zawal A (2003b) Parasitism of water mite (Hydrachnellae) larvae of genus *Eylais* on water beetles in Poland. *Acarologia* 43: 39–47.
- Zawal A, Çamur-Elipek B, Fent M, Kırgız T, Dzierzgowska K (2013) First observations in Turkish Thrace on water mite larvae parasitism of *Ranatra linearis* by *Hydrachna gallica* (Acari: Hydrachnidia). *Acta Parasitologica* 58: 57–63. <https://doi.org/10.2478/s11686-013-0106-1>